$$\bar{y}=\frac{b\cos\alpha(16\,a\sin\beta+3\,\pi\,b\,\cos\alpha\,\cos\beta)}{4(4b\cos\alpha\,\cos\beta+3\,\pi\,a\sin\beta}$$

The distance of the center of pressure below the surface of the water is

$$\frac{b\cos\alpha\,\cos\beta(16a\sin\beta+3\,\pi\,b\cos\alpha\,\cos\beta)+a\sin\beta(16b\cos\alpha\,\cos\beta+15a\,\pi\,\sin\beta)}{4(4b\cos\alpha\,\cos\beta+3\,\pi\,a\sin\beta)}$$

$$=\frac{32ab\sin\beta\,\cos\beta\,\cos\alpha+3\,\pi\,b^2\cos^2\alpha\,\cos^2\beta+15\,\pi\,a^2\sin^2\beta}{4(4b\cos\alpha\cos\beta+3\,\pi\,a\sin\beta)}.$$

Also solved by S. G. Barton.

239. Proposed by J. G. ROSE, B. A. (Oxion), Mt. Angel College, Oregon.

A uniform bar of length $2a$ is placed in a sloping position, its lower end on the ground (coefficient of friction being μ), its upper end in the air, the bar being supported by a rough fixed peg (coefficient of friction μ'), against which it rests. If h is the height of the peg from the ground, and if θ be the angle the bar makes with the horizon, when on the point of slipping, prove that θ is to be found from the equation

$$\sin\theta\,\cos\theta\,[(\mu-\mu')\cos\theta+\sin\theta\,(1+\mu\mu')]=\mu\,h/a.$$

Solution by S. G. BARTON, Ph. D., Clarkson School of Technology, Potsdam, N. Y.

Let R and R' be the pressures on the ground and peg, respectively, and W the weight. Then resolving the forces vertically and horizontally, and taking moments about the point on the ground, we have the three equations:

(1) $W=R+R')(\cos\theta+\mu'\sin\theta)$,

(2) $\mu\,R+R'(\mu'\cos\theta-\sin\theta)=0$,

(3) $R'h\csc\theta=Wa\cos\theta$, or $W=\dfrac{R'h}{a\sin\theta\,\cos\theta}$.

Substitute this value of W in (1), multiply the equation by μ and subtract (3) to eliminate R', and we have

$$\mu\cos\theta+\mu\,\mu'\sin\theta-\frac{\mu\,h}{a\sin\theta\,\cos\theta}-\mu'\cos\theta+\sin\theta=0.$$

Whence, $\sin\theta\,\cos\theta[(\mu-\mu')\cos\theta+\sin\theta(1+\mu\,\mu')]=\mu(h/a)$.

Also solved by G. B. M. Zerr and J. Scheffer.